

AMENDMENTS TO THE DRAWINGS:

The attached sheet of drawings includes changes to Figure 3. This sheet, which includes Figure 3, replaces the original sheet including Figure 3. In Figure 3, the graph has been corrected to correspond with common graph conventions in accordance with Examiner Binda's very helpful suggestions.

Attachments:

Annotated Sheet Showing Changes

Replacement Sheet

REMARKS

Claims 1-4, 11-14, 40-47, and 50-55 are all the claims presently pending in the application. The specification, the drawings, and claims 1-3, 13-14, 39, 43-45, 47, and 50 are amended to more clearly define the invention, claims 38-39 and 48-49 are canceled, and claims 51-55 are added. Claims 1 and 50 are independent.

Applicants appreciate the courtesies extended to the Applicants' representative during a telephone interview on February 21, 2006. During the telephone interview, Examiner Binda explained the objection to Figure 3 as is addressed in detail below.

These amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

Applicants also note that, notwithstanding any claim amendments herein or later during prosecution, Applicants' intent is to encompass equivalents of all claim elements.

I. THE CLAIMED INVENTION

An exemplary embodiment of the claimed invention, as defined by, for example, independent claim 1, is directed to a cross joint that includes a cross shaft member having four shafts each comprising a neck portion and a race portion, and shoulder portions between adjacent neck portions. The cross joint further includes rolling members adapted to rotate on the race portions, and bearing cups fitted to the respective shafts via the rolling members. The round-shaped section has a center of curvature at an outer side of the cross shaft member. The round-shaped section does not include a concave angled corner. The shoulder portions are subjected to roller burnishing for increasing a hardness of each surface of the shoulder

portions and for increasing a residual compressive stress immediately below each of the surfaces, and a residual compressive stress at a depth of up to 0.3 mm from each of surface of the shoulder portions subjected to roller burnishing is larger than a residual compressive stress at the deeper portions thereof.

Conventional cross joints have experienced fatigue breaking or bending fatigue at the shoulder area between the shaft neck areas because of the large bending stress experienced during operation.

In stark contrast to the conventional cross joints, the present invention provides a roller burnished shoulder between the necks of the shafts. In this manner, the fatigue strength, the hardness of the surface, and the residual compressive stress of the shoulders can be increased and, therefore, the life of the cross joint is extended. (Page 15, lines 2-13).

II. THE DRAWING OBJECTIONS

The Office Action objects to Figure 3 because that figure “does not make sense.” In this regard, Applicants thank Examiner Binda for the courtesies extended during a telephone conference on February 21, 2006, where Examiner Binda explained his concerns regarding Figure 3.

In response to Examiner Binda’s very helpful suggestions, this Amendment encloses a replacement drawing sheet which corrects Figure 3 to comply with recognized conventions regarding representing a residual compressive stress which increases as corresponding to an increase in the distance along the Y- axis from the origin, to provide the legends for the X-axis along the X-axis, and to correctly show the X-axis as extending from the origin of the graph. Applicants respectfully request withdrawal of this objection.

The Examiner also objected to Figure 3 for not showing a residual compressive stress as being larger than 800 MPa at depths of at least 0.3 mm as described by the specification at page 11, lines 8+ and page 12, lines 22+. In this regard, this Amendment amends the specification to more clearly describe that the residual compressive stress is larger than 800 MPa at a depth of up to 0.3 mm. Applicants respectfully request withdrawal of this objection.

The Examiner also objects to the drawings as failing to show “the round-shaped section does not include concave corner” as recited by independent claims 1 and 50.

However, the Examiner contradicts this allegation by pointing out that “Fig. 1 clearly shows that when the center of curvature is at the outer side of the cross shaft joint it forms a concave corner.” Therefore, the Examiner admits that Figure 1 “clearly shows” this feature.

In this regard, however, this amendment clarifies independent claims 1 and 50 to clarify that the round-shaped section does not include a concave angled corner. Figure 1 clearly illustrates a concave round-shaped corner and not a concave angled corner. Therefore, Figure 1 clearly illustrates an exemplary embodiment which does not include a concave angled corner.

Applicants respectfully request withdrawal of these objections.

III. THE SPECIFICATION OBJECTIONS

The Examiner objects to the specification as referring to “the inventors and the like.” In this regard, this Amendment amends the specification to remove the “and the like” recitation. Applicants respectfully request withdrawal of this rejection.

The Examiner objects to the specification as failing to provide proper antecedent basis for the subject matter recited by claims 41-43.

Regarding claims 41-42, Applicants respectfully submit that support for the features recited by these claims may be found in the specification at, for example, page 14, lines 7 - 23.

Regarding claim 43, Applicants respectfully submit that support for the features recited by this claim may be found in the specification at, for example, page 11, line 24 - page 12, line 7, and page 11, lines 8 - 22.

Applicants respectfully request withdrawal of these objections.

IV. THE 35 U.S.C. § 112, FIRST PARAGRAPH REJECTION

The Examiner alleges that claims 1-4, 11-14, and 38-50 are not enabled by the specification.

The Examiner alleges that there does not appear to be a written description in the specification for “the round-shaped section has a center of curvature at an outer side of the cross shaft member, wherein the round-shaped section does not include a concave corner.” In this regard, this Amendment amends the specification to include a written description with these features as very clearly supported by the Figures.

With regard to claim 1, lines 15-17, this Amendment amends claim 1 to clarify “a depth of up to 0.3 mm” rather than “at a depth of at least 0.3 mm.”

The Examiner alleges that there does not appear to be a written description in the specification for the features of claim 14, 45, and 47, in this regard, this Amendment amends claims 14, 45, and 47 to clarify that a hardness approximately equal to or larger than Hv700 from a surface up to a depth of approximately 0.4 millimeters and amends the specification to include a written description of this feature. Applicants respectfully submit that Figure 2

provide support for these features.

Applicants respectfully request withdrawal of these rejections.

V. THE 35 U.S.C. § 112, SECOND PARAGRAPH REJECTION

The Examiner alleges that claims 1-4, 11-14, and 38-50 are indefinite.

The Office Action rejects claims 1 and 50 for reciting “the round-shaped section has a center of curvature at an outer side of the cross shaft member, wherein the round-shaped section does not include a concave corner.”

In this regard, this Amendment amends independent claims 1 and 50 to clarify that the round-shaped section does not include a concave angled corner.

The Office Action rejects claim 1 for reciting a “residual compressive stress at a depth of at least 0.3 mm . . is larger than a residual compressive stress at the deeper portions.”

In this regard, this Amendment amends claim 1 to clarify that the residual compressive stress at a depth of up to 0.3 mm . . . is larger than a residual compressive stress at the deeper portions thereof.

The Office Action rejects claim 2 for reciting “a bearing cup” while claim 1, from which claim 2 depends, recites “bearing cups.”

In this regard, this Amendment amends claim 2 to clarify that a race portion formed on one of the bearing cups.

The Office Action rejects claim 13 for reciting “the roller burnishing of the shoulder increases a surface hardness of the shoulder” when claim 1, from which claim 13 depends, already recites “the shoulder portions are subjected to roller burnishing for increasing a hardness of each surface of the shoulder portions.”

In this regard, this Amendment amends claim 13 to remove this recitation.

Similarly, the Office Action rejects claim 46 for reciting “the roller burnishing of the race portion increases a surface hardness of the race portion” when claim 43, from which claim 46 depends, already recites “the race portions are subjected to roller burnishing for increasing a hardness of each surface of the race portions.”

In this regard, this Amendment amends claim 46 to remove this recitation.

Applicants respectfully request withdrawal of these rejections.

VI. CONCLUSION

In view of the foregoing amendments and remarks, Applicants respectfully submit that claims 1-4, 11-14, 40-47, and 50-55, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.


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The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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Corrections have been
made per Examiner's
Suggestions,

FIG. 3

